

Climate Change

What is climate change?

Normal Climate
The average temperature expected for a given day and location based on the weather records of that location.

Examples of climate change:

Weather:

- Rain
- Snow
- Wind
- Temperature

Climate:

- Average summer temperature
- Average minimum winter temperatures
- Total annual snowfall
- Total annual rainfall

Before you can understand climate change, you first need to consider the difference between weather and climate. Weather is what is happening in the atmosphere at any given moment – a snapshot of the bigger picture. Climate is a long-term average of weather. In Canada, we use a minimum of 30 years to establish a climate record, or “*normal*”, for an area.

So, what’s **climate change**? It is a change in the earth’s long-term weather patterns. Questions like, “is it getting colder, warmer, wetter, drier?” can be examined by studying climate records. Sometimes individual weather events or an abnormal season is mistaken as an indicator of climate change, but we have to look for long-term trends in weather and not just at individual events to tell if our climate is changing.

Many scientists believe that greenhouse gases like carbon dioxide and methane are building-up in the atmosphere and causing changes to the earth’s climate. These gases trap heat in the lower layers of the Earth’s atmosphere, thereby warming the planet. The main question around climate is whether anthropogenic (human generated) emissions are contributing to climate change and do we need to be concerned?

Is our climate changing?

It might be better to ask if our climate is the same today as it was in the past. The weather records in Alberta go back a little over 100 years. Although these records show some trends, it is only a small glimpse of past climate and weather.

To construct the climate before we started keeping weather records, we have to use other evidence. We can use the writings of the explorers, surveyors and pioneers to get a sense of recent past climate. Their descriptions of life in this era often contain references to weather events of their time. We can study tree rings and lake sediments to estimate past temperatures and precipitation.

To go back even further, scientists study the gases found in ice from drill cores taken from glaciers and ice sheets. These data sources are known as paleoclimate records. From these paleorecords, scientists have been able to build a record of Earth's past climate.

Our climate varies naturally over time. Over the last 100,000 years, the earth has had numerous ice ages. During the last ice age (approximately 15,000 to 10,000 years ago) the earth's climate was 4.5 °C colder than it is today. Several kilometers of ice from the Polar Regions covered most of Canada.

Figure 1 shows the Earth's average temperature for the last 1,000 years. This chart uses paleorecords (blue) and direct observations (red) to understand temperature change. The climate 1,000

years ago was relatively warm – enough that Vikings crossed the North Atlantic and created settlements in Greenland and Labrador. Several hundred years later, those settlements were abandoned because the climate became colder and made it impossible for people to survive in those areas.

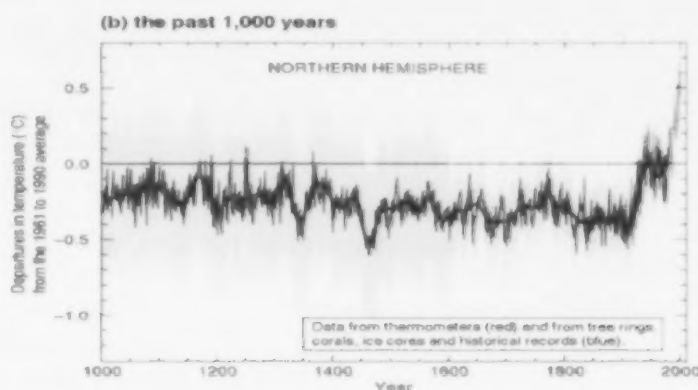
This period of colder weather is known as the 'Little Ice Age'. Although it was not cold enough to start glaciers marching across the prairies, it was cold enough that people in London (such as the writer Samuel Pepys) reported that the River Thames froze.

Many theories try to explain the natural variations in our climate; some involve changes in sunspots, debris from volcanic eruptions or changes in snow and ice cover. However, there is probably no single cause to climate change – all of these factors, as well as others, work together to influence our climate.

What is the greenhouse effect?

The greenhouse effect is the natural process that warms our atmosphere. Like the glass in a greenhouse, most sun energy passes through the atmosphere as if it were transparent. The energy is then absorbed by Earth's surface and radiated back into the atmosphere as heat.

The so-called "greenhouse gases" in the atmosphere - carbon dioxide, methane, and water vapour - trap much of this heat. Heat trapped by these gases keep



Earth's average temperature at a comfortable $+15^{\circ}\text{C}$. If we did not have this natural greenhouse effect, Earth's average temperature would be -18°C , a difference of 33 degrees! Without the natural greenhouse effect, life as we know it would not exist on Earth.

To put this into perspective, we need only look at our planetary neighbours, Venus and Mars. Venus contains an atmosphere that is 96.5% carbon dioxide. The temperature on the surface of Venus is $+750^{\circ}\text{C}$. On Mars, there is very little atmosphere to hold the heat released by the planet, and so the surface temperature of Mars ranges from -30°C to -120°C . Just like the three bears, our atmosphere is just right!

If the greenhouse effect is natural, what is all the fuss?

Since the beginning of the Industrial Age (around 300 years ago), many human activities have involved the burning of fossil fuels. The use of coal to power engines and heat homes released a tremendous amount of pollutants, as well as carbon dioxide, into the air. The more coal and, later, oil and gas that was burnt, the more emissions went in to the air. Since the 1700s, the amount of carbon dioxide in the atmosphere has increased by 25 per cent and most of this increase can be attributed to human activities. Scientists are concerned that if we continue to add greenhouse gases to the atmosphere, the atmosphere will absorb more heat and cause Earth's temperature to rise.

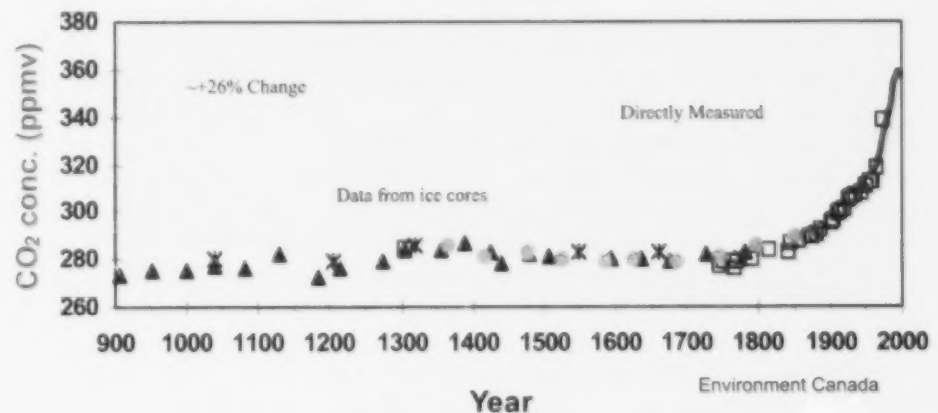


Figure 2: Measured changes in CO₂ concentrations in our atmosphere using paleorecords from ice cores (blue) and direct measurements (red).

Scientists use complex computer models to predict the effects of increased levels of greenhouse gases in the atmosphere. All models are predicting a global rise in temperature up to 4.5°C by the year 2100. The International Panel on

Climate Change (IPCC) 2002 assessment report states: "*Most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations*". Precipitation on the other hand, is much harder to predict. Some models predict more rain and snow while others predict less. There are also regional variations in temperature and precipitation that are harder for the models to predict.

Human activity is raising the amount of greenhouse gases in the atmosphere. Many scientists believe that by increasing the concentrations of these gases, we are affecting our climate.

What are the possible effects of climate change in Alberta?

While warmer temperatures in February might sound nice, the issue of climate change is much more complex. Environment Canada records suggest that our winters are getting warmer with fewer days of very cold weather. In fact, these records indicate that Alberta's average temperatures from 1900 – 1998 have increased by 1.5°C, with most of the warming occurring during the spring and winter.

Changes to climate mean different things to different groups. Shorter winters mean shorter ski seasons, but longer summers mean longer golf seasons. A warmer climate can affect the water quality in our lakes, shift the southern edge of the boreal forests north, and alter our forests as native trees may not be able to survive in warmer conditions.

One of the benefits of cold winter temperatures below -40°C is the control of the spread and range of insects like the pine beetle and mosquitoes that carry diseases like the West Nile virus. Warm winters are expanding the range of these insects, which put our forests and our health at risk.

Warmer temperatures may lead to changes in our precipitation patterns. We may have longer and more severe droughts, which will impact food and water supplies. More precipitation may fall as rain instead of snow, which means less spring runoff. We may get more rain, but if it comes too late in the summer it will not be available for growing crops. If we get too much rain at one time, it could cause more flooding.

Unfortunately, it is not just the change in our climate we have to be concerned with, but also the *rate of change*. If our activities cause the climate to change faster than it would naturally, there is a great concern that we will have to adapt quickly to the effects of these changes.

Climate affects almost everything in our lives. Our ability to adapt to these changes will affect our economy, our lifestyle and our environment. While

A drought in the 1850s caused the North Saskatchewan River to dry up. This made it impossible for fur traders to paddle down the river in their canoes.

Can birds adapt? Birds migrate based on daylight hours, which is constant. Their food—insects and flowers—hatch or bloom based on temperature. If these come too early, there will not be any food for the hatchlings to eat.

humans may be able to adapt to these changes, animals, trees, and ecosystems may not be able to adapt as quickly – putting them at risk.

So what can we do about climate change?

Most human-produced greenhouse gas emissions result from the use and production of energy. Most developed countries are working to control and reduce these emissions.

Alberta is doing its share to manage emissions. In 2002, Alberta released its action plan, *Albertans and Climate Change: Taking Action*, which lays out Alberta's approach to managing greenhouse gas emissions in the province. In 2003, the government passed the *Climate Change and Emissions Management Act* (CCEMA). This was the first emissions management act in Canada. In 2004, Alberta was the first jurisdiction in Canada to establish greenhouse gas reporting regulations, when we passed the *Specified Gas Reporting Regulation* under the CCEMA. The regulation requires all facilities emitting over 100 Mt of greenhouse gas emissions a year to report their emissions. This will help us track how many greenhouse gas emissions are being released by industries in the province. Together, the Alberta and Canadian governments work with industry to set *emissions intensity* targets.

Emissions Intensity

Focuses on the content of emissions relative to output, instead of total volume. It is measured against a factor such as GDP, unit of oil, gas, or electricity.

However, industry is not the only source of greenhouse gas emissions. Daily activities, such as heating homes, driving cars, and using electricity all emit greenhouse gases. You can make a difference by considering and modifying your own energy use and conservation.

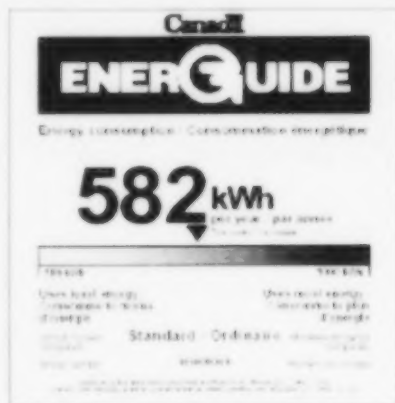
- Make sure your home heating system and vehicles are in good repair.
- Make sure your house is properly insulated so your heating system doesn't have to work as hard. Changing your furnace filters on a regular basis will help keep your heating system efficient.
- When purchasing a vehicle, choose the right size and power for your needs. If you have a large family, a van may be the right choice. If you use a truck once or twice a year, consider borrowing or renting rather than buying. A large engine may be necessary if you tow a trailer, but if most of your driving is just around the city, consider a smaller vehicle. You will save money and reduce your impact on the environment.
- If purchasing new appliances, look at the energy ratings displayed on all new appliances. It may cost a little more to purchase an energy efficient model, but in the long run you make up the difference in operating costs. Energy efficiency not only helps reduce emissions, it also saves you money – it's a win for you and the environment.
- Practice simple actions like turning off the lights when you leave a room or installing motion sensors that turn the lights off for you.

Did you know

A Fridge built in 1990 uses 1067 kwh of electricity in a year and costs \$91 to run. A new energy efficient fridge uses 426 kwh of electricity and costs only \$36 per year.

Energy Efficiency and You

Energy Star is an energy efficiency certification program operated by the United States Department of Energy and the Environmental Protection Agency. This program certifies products that meet the highest standards for energy efficiency. In 2005, Americans saved \$12 billion on their energy bills and avoided 23 million cars worth of CO₂ emissions. Energy Star products can be bought around the world.



Energuide is an energy efficiency program managed by Natural Resources Canada. The Energuide program provides consumers with information on energy efficient products. For example, a consumer can compare how much energy they will save by buying a front load washing machine compared to a standard washing machine and calculate total savings and emissions.

Carbon Dioxide Reduction Edmonton (CO₂RE) is a City of Edmonton program that is helping the City of Edmonton and Edmonton residents reduce their CO₂ emissions. They have helpful hints for homeowners and industry.

For more information

For more information on climate change and action in Alberta, please visit the following websites:

Energy Star : www.energystar.gov

Energuide :

oee.nrcan.gc.ca/equipment/english/index.cfm?Text=N&PrintView=N

CO₂RE, Edmonton's Greenhouse Gas Reduction and Energy Strategy:

www.co2re.ca

Climate Change Central: www.climatechangecentral.com

Alberta Environment's State of the Environment:

www3.gov.ab.ca/env/soe/air.html

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Last update: January 2008

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ISBN: 0-7785-7202-2 (Printed)
ISBN: 0-7785-7203-9 (On-Line)
Pub No. 1/870

